The Alternative Fuels Being Tested

Methanol. Methanol is an alcohol produced primarily from natural gas, but it can also be derived from biomass or coal. For this reason, the domestic resource base for methanol is vast. The methanol buses in the program run on 100% methanol.

Ethanol. Ethanol is an alcohol derived from biomass (corn, sugar cane, grasses, trees, and agricultural waste). The ethanol used in the test buses was E93 (93% ethanol, 5% methanol, and 2% kerosene) or E95 (95% ethanol and 5% unleaded gasoline).

Biodiesel. Biodiesel fuel can be derived from any plant- or animal-derived oil product. The biodiesel blend used in the test buses, called BD20, was 20% biodiesel from soybeans and 80% diesel fuel. (Note: BD20 is not currently considered an alternative fuel under the Energy Policy Act of 1992).

Natural Gas. Natural gas is composed primarily of methane. It can be stored on the vehicle as a compressed gas or as a cryogenic liquid. The program includes vehicles that employ both types of storage.

agencies, converts the information into a standard form for submission to the data center, and analyzes the results. AFDC personnel then make the data available to the public through a series of data base queries and descriptions designed to present the information in a concise and logical format. Reports are also available over the Internet using Worldwide Web browsers such as Mosaic and Netscape. The internet address for the AFDC is:

http://www.afdc.nrel.gov:70/

Our goal is to collect 18 months of data on each test bus. Currently, we have approximately 18 months of data for only three of the seven sites. This report summarizes the interim results from the project to date. A more detailed interim report of the program will be available at a later date from the National Alternative Fuels Hotline.

In the sections that follow, we address the performance and reliability, fuel economy, costs, and emissions of the buses in the program. Other considerations for transit agencies are also covered. The final sections of the report outline the future plans for the program, including potential new sites with alternative fuel transit buses, and summarize the interim results.

Reliability

One measure of reliability in a bus is the average number of miles a bus travels between road calls. When the driver cannot complete a route because of a problem with the bus and calls for a replacement bus, a road call is recorded. Road calls encompass all types of events from engine failure to simply running out of fuel. Figure 4 shows the miles between road calls for the buses in the test program. The sections that follow provide a discussion of reliability by fuel type.

Liquefied Natural Gas

As seen in Figure 4, the dual-fuel buses in Houston running on LNG and diesel are experiencing considerably more road calls than the diesel controls—about 1,800 miles between road calls for LNG versus 3,300 miles between road calls for diesel. These roads calls are due mainly to two problems: the buses ran out of fuel (63 out of 213 total road calls), or the monitoring system detected a fuel leak and shut down the bus (44 out of 213). If a fuel problem develops with the LNG, the dual-fuel engines will switch to diesel as a backup. Because the dual-fuel buses have very small diesel

fuel tanks, the bus runs out of diesel in a short time; the diesel fuel tank alone is not adequate to run the bus independently for long distances. The dual-fuel buses experienced more than six times the rate of road calls for "out of fuel" as did the diesel controls.

In the future, we will add an additional site for buses running on LNG. The additional buses will have different engines—Cummins L10G burning LNG exclusively.

Compressed Natural Gas

Buses running on CNG traveled about 38% fewer miles between road calls than their diesel controls in Miami (despite the fact that the diesel buses are older, with higher mileage), but traveled about 10% more miles between road calls in Tacoma. The total mileage accumulated on the Miami CNG buses is quite limited because the CNG buses are only being used an average of 1,000 miles per month.

Ethanol

Both the ethanol buses and the diesel control buses with particulate traps operating in Peoria ran relatively long distances between road calls—about 7,500 and 7,900 miles, respectively. In Minneapolis/St. Paul, the E95 buses traveled an average of 5,200 miles between road calls, versus 2,200 miles for the diesel control buses. However, the E95 buses are not used as heavily as the diesel buses—1,300 versus 3,800 miles per bus each month.

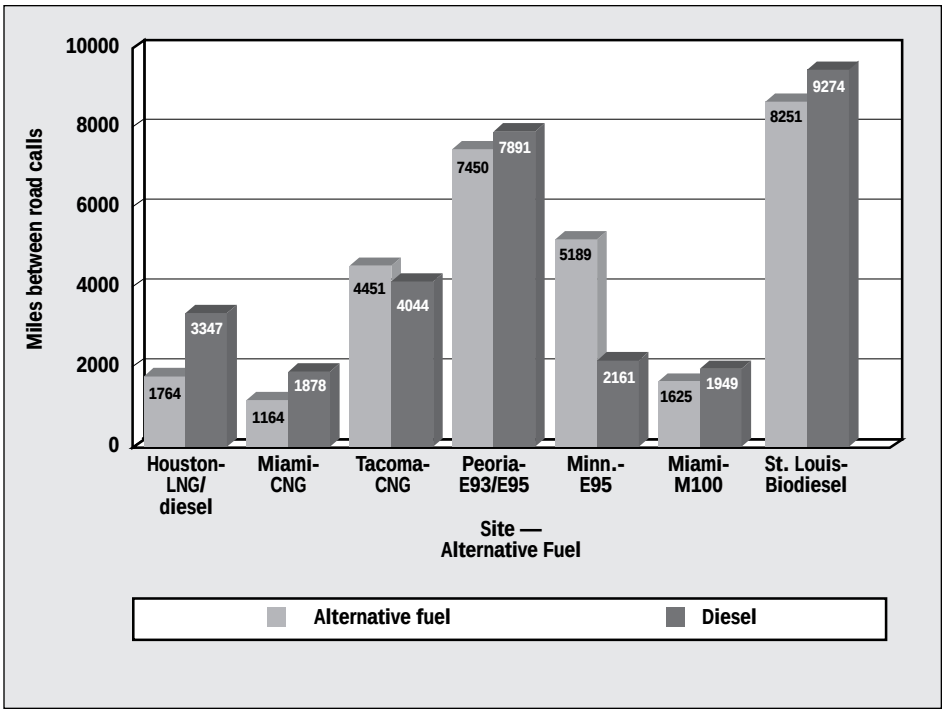

Figure 4. Average miles traveled between road calls at each site

Methanol

The Miami buses operating on M100 traveled fewer miles between road calls than their diesel counterparts—about 1600 miles versus 1900 miles for the diesel control vehicles. This difference is primarily due to fuel system problems that resulted in engine stalls in the methanol buses. Many of the engine stalls were caused by clogged fuel filters, which may indicate a problem with fuel supply, not with the engine (fuel filter clogging has also been a problem with the ethanol buses). We recently added a second site—New York City (Triboro)—to test more buses running on M100 and see if similar problems are encountered.

Biodiesel

The biodiesel and diesel buses in St. Louis traveled relatively long distances between road calls: about 8,300 miles for the biodiesel buses and 9,300 for the diesel buses.